Development of Nutrient Criteria in New Mexico, 2010

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Stream Nutrient Assessment

Stream nutrient assessment is unchanged and uses a weight of evidence approach with a number of indicators:

An Assessment Unit will be determined to be not supporting if **three or more** of the following indicators are present

____ **Total nitrogen** is above the applicable threshold in >15% of samples

- ____ **Total phosphorus** is above the applicable threshold in >15% of samples
- ____ **Dissolved Oxygen** threshold is exceeded
  - (____) determined to be **not supporting** using the assessment protocol for Data Collected with Continuous Recording Devices
  - (____) >15% of grab samples exceeded 120%
  - (____) >15% of grab samples are below the applicable standard
- ____ **pH** threshold is exceeded
  - (____) determined to be **not supporting** using the assessment protocol for large pH data sets
  - (____) >15% of grab samples exceeds appropriate criterion
- ____ **Algal biomass** threshold is exceeded

Ecoregion and Aquatic Life Use Nutrient Thresholds for Streams (mg/L), using regional data and the 50th percentile

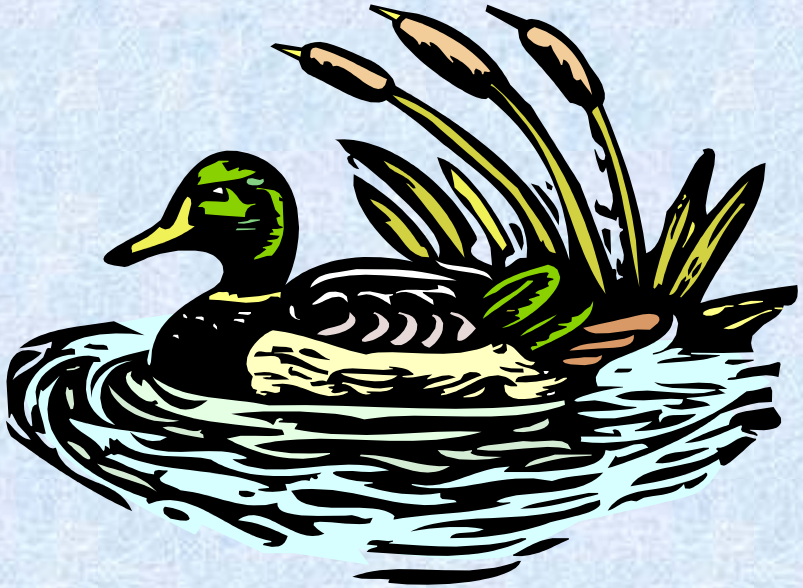
	21 – Southern Rockies		22 – AZ/NM Plateau		23 – AZ/NM Mountains		24 – Chihuahuan Desert	26 – Southwest Tablelands		
TN	0.25		0.35		0.25		0.53	0.38		
TP	0.02		0.05		0.02		0.04	0.03		
ALU	CW	T – WW (volcanic)	CW	T – WW	CW	T – WW	T – WW	CW	T	WW
TN	0.25	0.25	0.28	0.48	0.25	0.29	0.53	0.25	0.38	0.45
TP	0.02	0.02 (0.05)	0.04	0.09	0.02	0.05	0.04	0.02	0.03	0.03

CW = Coldwater Aquatic Life Use
T = Transitional Aquatic Life Use
WW = Warmwater Aquatic Life Use

SWB 2009

Ecoregional Chlorophyll *a* threshold values (95th percentile) in µg/cm^2

21- Southern Rockies	22/20- AZ/NM Plateau	23- AZ/NM Mountains	24/79- Chihuahuan Desert	26/25- Southwest Tablelands
5	8	7	17	11



• **Benthic Macroinvertebrates Stream Community Index and/or Hilsenhoff Biotic Index (*still under development*). SWQB is in the process of developing new database and was discouraged to find the new EDAS did not have the capabilities of the old version when it came the metric calculation. Database is nearly complete!!!**

•**Diatom Nutrient Index - SWQB provided Philadelphia Academy of Natural Sciences (PANS) with 330 stream and river periphyton samples collected between 2004 and 2008 and funded in part by 104b grants from EPA . Preliminary analysis did not reveal a better waterbody classification system or diatom index that discriminated sites with more human influence from those with less. This is probably due to the high diversity of NM streams, the relatively small size of the dataset, and the need to refine the human influence scores. We will continue to explore use of diatoms**

Lakes and Reservoirs

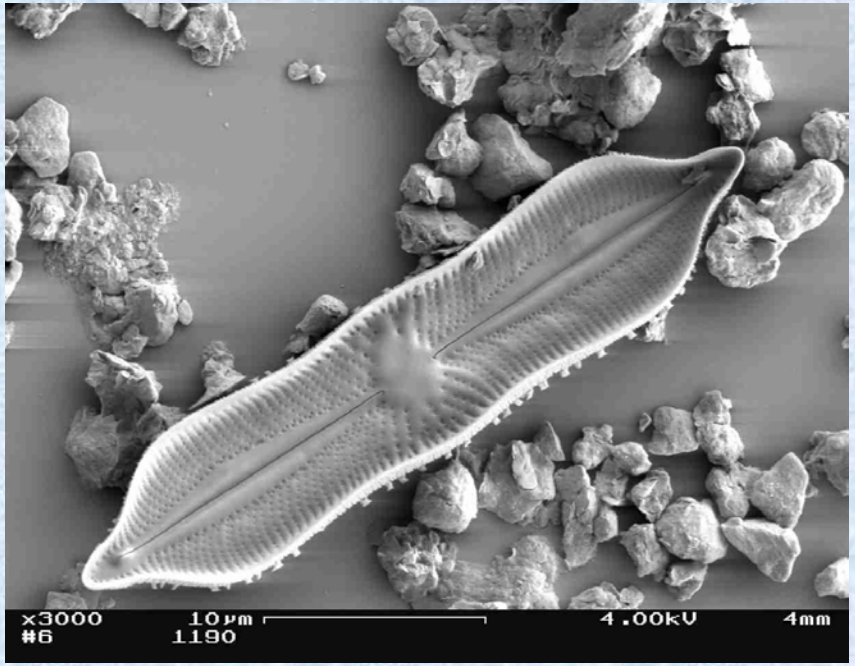
Lakes Dataset

- In 2006 and 2007, SWQB sampled 25 lakes and reservoirs, including cirque lakes, sink holes, and warm and coldwater reservoirs for the following parameters
  - Total Phosphorus
  - Total Kjeldahl Nitrogen
  - Nitrate Plus Nitrite
  - Secchi depth
  - Chlorophyll *a* concentration
  - Phytoplankton Community Comp.
  - Diatom Community Comp.
  - Dissolved Oxygen
- Water quality data from 2000-2007 was compiled from the SWQB Database
- Water quality data from 1980-1999 was downloaded from Archival STORET

All **diatom and phytoplankton** data were in word documents, as none of the BIOS data was transferred to archival STORET !!!

Much times was spent compiling the diatom and phytoplankton data, harmonizing the taxa, and calculating some metrics

These data are now nearly ready to upload to our new database during the next phase of its development



Data mining effort resulted in the following:

- Water quality data from 1989 through 2007
- 406 sample events from 107 sites on 78 lakes and reservoirs
- the proportion of Cyanophytes (i.e. blue-green algae) was determined for the 123 sample events with phytoplankton data

Growing season definitions for ecoregion and elevation classes

Regions	Ecoregion Names	Ecoregion #	begin	end	Length
Mountain >7500 ft	S. Rockies & AZ/NM Mountains	22 & 23	July	Oct	3 months
Mountains <7500 ft & Plateau	S. Rockies, AZ/NM Mountains & AZ/NM Plateau	20, 21, 22 & 23	15-Jun	Nov	4 ½ months
S. Deserts and Plains	SW Tablelands & Chihuahuan Desert	24, 25, 26, & 79	15-May	15-Nov	6 months

Natural lakes were separated from man-made reservoirs and then further divided the natural lakes into cirque lakes or sinkholes.

Dissolved Oxygen Profiles

For dissolved oxygen, the top and bottom 3 meters were averaged and the percent of the profile that was below the applicable standard was calculated.

The percent of profile below the standard did not show a trend of increasing proportion of low DO with increasing levels of TN and/or TP, this is probably due to the influence of stratification.

Data Analysis

Percentiles of nutrient indicators for coldwater and warmwater reservoirs during the growing season

	CWAL (n = 181)			WWAL (n = 161)		
	25th percentile	50th percentile	75th percentile	25th percentile	50th percentile	75th percentile
Total Phosphorus	0.02 mg/L	0.03 mg/L	0.05 mg/L	0.02 mg/L	0.04 mg/L	0.06 mg/L
Total Nitrogen	0.28 mg/L	0.50 mg/L	0.80 mg/L	0.35 mg/L	0.60 mg/L	0.80 mg/L
Secchi Depth	3.0 m	1.5 m	0.80 m	2.1 m	1.0 m	0.50 m
Chlorophyll *a*	1.24 µg/L	2.3 µg/L	6.1 µg/L	1.62 µg/L	3.2 µg/L	10.3 µg/L

Percentiles for aggregate ecoregions

	Total Phosphorus (mg/L)			Total Nitrogen (mg/L)			n
percentiles	**25th**	**50th**	**75th**	**25th**	**50th**	**75th**	
Mountains (21 & 23)	0.017	0.045	0.060	0.37	0.58	0.83	129
Xeric (20, 22, & 24)	0.015	0.040	0.070	0.32	0.56	0.79	149
Plains (26)	0.015	0.025	0.048	0.39	0.52	0.98	107

Correlations of nutrient and classification variables

	Secchi Depth	Spec. Cond.	Alka-linity	TSS	nL TKN	nL Nitrate + Nitrite	nL TP	nL TN	Hard-ness	Chloro phyll_ A	% depth < DO criteria	Ave. DO of top 3m
TSS	-0.1602	0.4947	0.1042									
nL TKN	-0.1592	0.3105	0.3629	0.0500								
nL Nitrate+Nitrite	-0.2220	-0.1065	-0.2188	0.0003	-0.1511							
nL TP	-0.2611	0.0591	0.1965	0.0246	0.5467	-0.0347						
nL TN	-0.1905	0.3037	0.3399	0.0574	0.9875	-0.0182	0.5626					
Hard-ness	-0.1544	0.9307	0.1453	0.3345	0.2262	-0.1122	0.0301	0.2138				
Chloride	-0.0736	0.8648	0.0715	0.4094	0.2884	-0.0882	0.1069	0.2939	0.8168			
Chloro-phyll_A	**- 0.3487**	-0.0316	0.2374	0.0267	0.4230	-0.1052	**0.3794**	**0.4307**	-0.0689			
% depth < DO criteria	-0.0699	-0.2468	-0.1462	-0.1167	-0.2943	0.1013	-0.1012	-0.2637	-0.1453	0.1195		
Ave. DO of top 3m	0.0734	-0.0641	0.0903	-0.0755	0.1505	-0.0718	-0.0119	0.1306	-0.1000	0.0282	-0.4946	
% Cyano-phytes	-0.1509	-0.1105	0.3128	-0.1867	0.4940	-0.1810	**0.4149**	**0.4934**	-0.1239	**0.4459**	-0.0137	0.3034

Draft Lake Assessment

Preliminary threshold values for Reservoirs -

- the 25th and 75th percentiles for TP and TN
- 50th percentile for Secchi and Chlorophyll a
- literature values for other parameters

Designated Use/ Lake Class	TP (mg/L)	TN (mg/L)	Secchi depth (m)	Chl-*a* (µg/L)	Blue Green Algae[1]	% DO profile below criterion
Reservoirs						
Coldwater	0.03 – 0.5	0.5 – 0.8	1.5	2.3	>50%	>50%
Warmwater	0.04 – 0.6	0.6 – 0.8	1.0	3.2	>50%	>50%
Domestic Water Supply	n/a	10.0 mg/L[2] (Nitrate as N)	1.0	10	20,000 per mL	>50%
Natural Lakes						
Cirque Lakes	0.03	1.5	3.5	2.0	n/a	>50%
Sinkholes	0.034	2.4	6.0	n/a	n/a	>50%

Preliminary threshold values for Lakes – 95th percentile

- A lake will be determined to be **not supporting** due to nutrient impairment if **three or more** of the indicator groups exceed their respective threshold value (for TP and TN that value is the upper threshold (75th percentile)).

- If less than two of the indicator groups exceed the thresholds and one or both of the nutrient concentrations are below the lower threshold (25th percentile), the waterbody will be determined to be **fully supporting** its designated uses.

- If 2 of the indicator groups exceed the threshold or both of the nutrient concentrations are between the upper and lower thresholds, the indicators will be evaluated individually and other observations (e.g. the presents of fish kills or diatom community composition) will be used to determine use support.

Examples of lake and reservoir assessments.

	LAKE STATIONS			
Nutrient Indicators	**San Gregorio Deep 33SanGregorLk**	**Abiquiu at Dam 29AbiquiuRDam**	**Stone Lake - 29StoneLake**	**Ned Houk Park Lake 21NedHoukLkDp**
Total Phosphorus (mg/L)	0.075	0.005	0.045	0.112
Total Nitrogen (mg/L)	1.35	0.32	1.15	1.66
Secchi Depth (M)	0.65	0.8	4.00	0.25
Chlorophyll *a*	29.80	1.40	3.04	
% Bluegreen algae	71.7	0.0	4.0	23.0
% Depth below criteria	0	38	0	0
Group exceedences	3	1	1	2
Individual exceedences	5	1	1	3
Support Determination	Non-support	Full Support	Full Support	Non-support

NOTE:

* exceedences of the threshold value are highlighted in **bright yellow**
* nutrient concentrations below the 25th percentile are highlighted in **pale yellow**

Stone Lake only has one exceedence but neither of the nutrient concentrations are below the lower threshold; however, there is only one exceedence and no other indications of eutrophication were observed.

Ned Houk Park Lake has exceedences in 2 indicator groups however it has 3 individual exceedences and a dominance of eutrophic diatoms,

Rivers

Preliminary River Definition

- SWQB is distinguishing rivers from streams by defining systems that cannot be monitored effectively with the biological and habitat methods developed for wadeable streams. These rivers also generally meet the Simon and Lyons (1995) definition of great rivers as those having drainage areas greater than 2,300 square miles. There are many systems is in New Mexico that meet the great river definition but are suitable to wadeable streams monitoring methods due to the arid nature of the region.

- The systems currently included in the "rivers" waterbody type are:
  - The San Juan River from below Navajo Reservoir to the Colorado border
  - The Rio Grande in New Mexico,
  - The Pecos River from below Sumner Reservoir to the Texas border,
  - The Rio Chama from below El Vado Reservoir to the Rio Grande,
  - The Canadian River below the confluence with the Cimarron River,
  - The Gila River below Mogollon Creek.

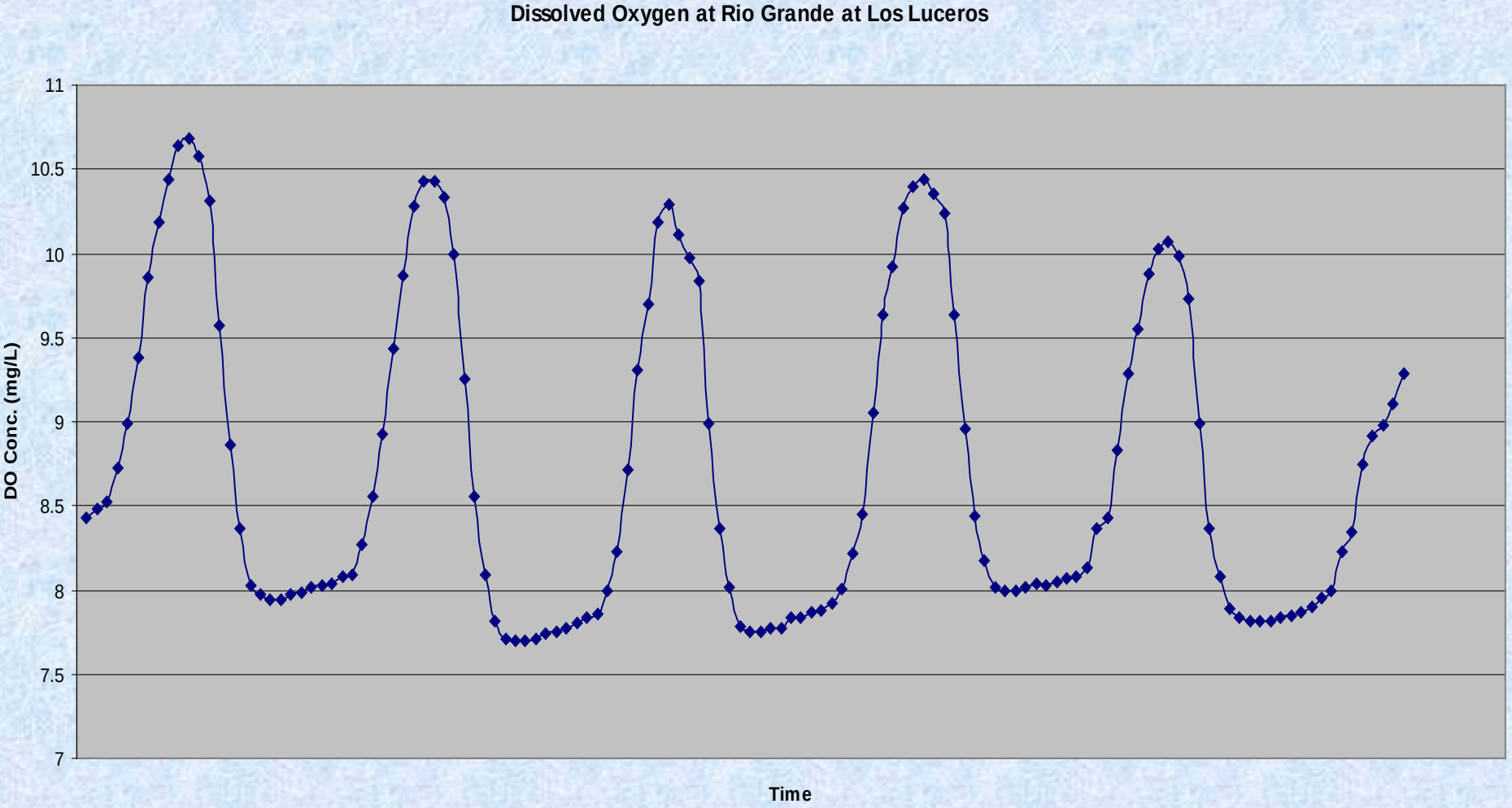
Data from NM Rivers

- **SWQB compiled the historic river dataset of the following parameters:** Total Phosphorus, Total Kjeldahl Nitrogen, and Nitrate Plus Nitrite **AND** DO Conc. and % Saturation and Chlorophyll *a* concentration where available

- **Diurnal DO Flux data were also compiled**

- **This effort resulted in a good dataset of cause variables (n ~ 3000) but few response variables**

Diurnal DO Flux



Diurnal DO Flux Values

2.40	2.74	2.73	2.59	2.67	2.25

SWQB developed preliminary site-specific targets that vary according to the waterbody and where the river crosses ecoregional boundaries the ecoregion. The 25th, 50th, and 75th percentiles were calculated

	Total Phosphorus (mg/L)			Total Kjehldal N (mg/L)			Nitrate + Nitrite (mg/L)			Diurnal DO Flux (mg/L)		
percentiles	**25th**	**50th**	**75th**	**25th**	**50th**	**75th**	**25th**	**50th**	**75th**	**25th**	**50th**	**75th**
Animas River	0.020	0.040	0.110	0.175	0.230	0.390	0.050	0.085	0.198	1.47	1.68	1.93
Canadian River	0.015	0.030	0.052	0.300	0.400	0.658	0.025	0.050	0.085	0.875	1.42	1.65
Gila River	0.040	0.070	0.140	0.195	0.310	0.560	0.128	0.255	0.466	no data	no data	no data
Pecos River (TX border to Salt Crk)	0.015	0.040	0.090	0.480	0.700	1.00	0.050	0.180	0.600	no data	no data	no data
Pecos River (Salt Crk to Sumner Rsv)	0.010	0.020	0.070	0.160	0.260	0.353	0.025	0.025	0.100	1.39	1.47	1.71
Rio Chama (Rio Grande to El Vado)	0.024	0.060	0.100	0.200	0.300	0.400	0.025	0.050	0.050	0.850	1.13	1.26
Rio Grande (Hwy 528 in ABQ to CO)	0.040	0.090	0.230	0.300	0.440	0.710	0.050	0.110	0.280	0.835	1.22	2.22
Rio Grande (TX to Hwy 528 in ABQ)	0.090	0.200	0.320	0.470	0.660	0.930	0.130	0.300	0.720	0.998	1.18	1.70
San Juan River	0.030	0.093	0.280	0.200	0.320	0.560	0.050	0.150	0.260	1.73	1.87	1.99

Future Work

- Collect more regional data on algal biomass, diurnal DO patterns, and associated nutrient levels from rivers and lakes.
- Incorporate biotic indices (benthic macroinvertebrates and diatoms) into our assessment protocols (explore use of TITAN)
- Do more in depth analysis of datasets to explore effects-based nutrient targets
- Examine other classification schemes (besides ecoregion).
- Develop a use support rating for rivers, lakes, and reservoirs.
- Analyze lake and reservoir data with use support rating to define threshold values for TP, TN, chlorophyll *a*, and secchi depth.
- Further research the use of DO fluctuations and saturation.

THE END

http://www.nmenv.state.nm.us/swqb/Nutrients/index.html

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